LOWER MUD RIVER, MILTON WV DRAFT LIMITED REEVALUATION FLOOD REDUCTION FEASIBILITY STUDY

APPENDIX D
ECONOMICS

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I. PURPOSE

The purpose of this Economic Appendix is to: 1) revaluate flooding and related problems in the Lower Mud River floodplain in the Town of Milton, West Virginia; 2) determine the National Economic Development (NED) benefits and costs associated with potential solutions and 3) provide supporting information for the main report and Environmental Impact Statement (EIS).

II. METHODOLOGY

Methodology employed for this economic analysis is in accordance with current Principles and Guidelines and standard economic practices. A risk-based analysis was employed, which accounts for uncertainties in economic and hydrologic and hydraulic estimates. This is done by use of statistical distributions and standard deviations as measurements of error for major input variables required to model flooding in a floodplain. Benefits and costs are computed at October 2002 (FY 03) price levels. The analysis employs the currently established Federal discount rate of 5-7/8 percent. The period of analysis is 50 years.

III. STUDY AREA

a. Location

The Study Area is located within the city limits of the Town of Milton, West Virginia. This small community of 2,206 people is located in Cabell County, in the southwestern portion of West Virginia. The town falls in-between two of the largest Metropolitan Statistical Area's (MSA) in the state; the Huntington-Ashland-Ironton MSA, and Charleston MSA. The town of Milton is 30 miles west of the state's Capital of Charleston. The area outside of the town of Milton is primarily rural and sparsely populated. The largest urban center in the county is Huntington. Milton was compared to Hurricane and Barboursville, which are comparable in size, location and economic makeup, in order to provide a better understanding of the project area. Barboursville is 15 miles west of Milton in the direction of Huntington and Hurricane is 15 miles east in the direction of Charleston.

b. Economic History

The town of Milton, like many other small towns in West Virginia, started out as a transportation town. It started as a stop along the James River and Kanawha Turnpike in the late 1700's. This was the main east west artery until the completion of the Chesapeake and Ohio Railroad which was officially opened in 1871. In 1872 the town depot was built along the railroad, with its completion came the first significant development in the town. The town was laid out in lots on both sides of the track. The lots were soon filled with buildings that supported the supply of goods and materials to nearby counties. The town was incorporated in 1876 by the Cabell County Circuit Court. From this period until 1900 the town's population increased from 86 persons in 1876 to 582 in 1900. During this time there was an economic surge. Quality timber

from nearby counties was floated down the Mud River to the town of Milton where many sawmills were built. The lumber was then converted to finished products that were exported as far as Europe. Grains were also floated down the Mud and brought from nearby counties to be milled. Tobacco was the main cash crop in the area for many years. Packaging warehouses sprung up in Milton for packing and storing the tobacco for shipping. Other significant areas of growth were in the woolen industry. Raw wool was brought into Milton to be turned into yarn. The benefits that the railroad provided the town came to a close in 1909 when the C. & O. Railroad bypassed the town in order to provide a better grade for their tracks. This section of track was later converted to US Route 60, which was the main road form Charleston to Huntington until the completion of Interstate 64. Another important economic development in Milton was the establishment of the Blenko glass plant in 1922 by William Blenko.

c. Socioeconomic Characteristics

Future population in the town of Milton is estimated to follow the same growth trend as Cabell and Kanawha Counties, primarily due to the influx of people who work in the two counties. The town of Milton has future plans to upgrade water systems and other public facilities. This future projection is anticipated to occur with or without a federally sponsored flood control project (US Census Bureau 2000 data was compiled to describe the socioeconomic characteristics for the study area). Table 1 shows actual & projected population for Milton and Cabell County.

The total 2000 population in Milton is 2,206 with fifty-three percent of the population being female. The median age of Milton residents is 38.9 years. Forty percent of the population is between the ages of 25 years and 54 years. Residents over the age of 55 account for 29 percent of the population. Fifty-six percent of the population of age 15 years and older are married. Milton is a predominately white community; residents of African American descent or from other races comprise of less than 1% of the total population. English is the primary language spoken by 98 percent of residents in Milton (U.S. Census Bureau, 2000).

Table 1
Actual & Projected Population

Year	Town of Milton	Cabell County	Kanawha County
2025	2,098 est.	92,432 est.	177,409
2015	2,134est.	93,189 est.	183,691
2005	2,170 est.	94,473 est.	192,696
2000	2,206	96,784	200,073
1990	2,242	96,827	207,619

d. Housing

The average household size in Milton is 2.18 people, while the average family size is 2.78 people. There are a total of 1,112 housing units in Milton; 48% of these structures were built before 1960. Sixty-three percent of these structures are detached 1-units. Mobile homes account for 13 percent of housing structures. Approximately ten percent of the total housing

units are vacant while 35 percent of occupied housing units are rented. The average household size of owner-occupied units is 2.22 people and the average household size of renter-occupied units is 2.12. Nearly 31 percent of all households contain individuals less than 18 years of age. Households with individuals 65 years and older comprise nearly 32 percent of the total household population. Family households compose 62 percent of all household types. Of the total family households, 46 percent are married-couple families and 13 percent are female householders without a husband present. Table 2 shows number of housing units, unoccupied units, average household size and percentage of houses built before 1960 for Milton, Hurricane, and Barboursville.

Table 2
Housing

	Total Housing Units		Unoccupied units		Aver Household size		% of Houses Built
	1990	2000	1990	2000	1990	2000	before 1960
Milton	1,065	1,112	106	103	2.32	2.18	48%
Hurricane	1,831	2,312	118	144	2.60	2.52	24%
Barboursville	1,180	1,446	73	94	2.40	2.27	33.3%

The median household income in 1999 was $29,348. In 1999, 20 percent of households earned between $25,000 and $34,999, 42 percent earned less than $25,000, and 37.4 percent earned more than $35,000. Nearly three percent of the total households in Milton earned more that $100,000 a year.

e. Industry

All industries in this sector share a commonality of process, namely labor inputs of health practitioners or social workers with the requisite expertise. Many of the industries in the sector are defined based on the educational degree held by the practitioners included in the industry. Morris Memorial Nursing Home is a major employer in this sector. The Retail Trade sector is the second largest with 15.2%. This sector is comprised of establishments that are engaged in retailing merchandise, generally without transformation, and rendering services incidental to the sale of merchandise. Excluded from this sector, however, are eating and drinking places and mobile foodservices (which are now in the Accommodation and Foodservices sector); pawn shops (which are now in the Finance and Insurance sector); and bakeries (which are now in the Manufacturing sector). In addition, this sector now includes industries previously classified in Wholesale Trade that sold merchandise using facilities open to the general public. Prominent examples of these are automotive supplies dealers, computer and peripheral equipment merchants, office supplies dealers, farm supplies dealers, and building materials dealers. The Accommodation and Foodservices sector is comprised of establishments providing customers with lodging and/or prepared meals, snacks, and beverages for immediate consumption. Arts, Entertainment, Recreation, Accommodation and Food Services made up an additional 10.1% of Milton employment and ranks third. The Arts, Entertainment, and Recreation sector includes a wide range of establishments that operate facilities or provide services to meet varied cultural,

entertainment, and recreational interests of their patrons. This sector comprises (1) establishments that are involved in producing, promoting, or participating in live performances, events, or exhibits intended for public viewing; (2) establishments that preserve and exhibit objects and sites of historical, cultural, or educational interest; and (3) establishments that operate facilities or provide services that enable patrons to participate in recreational activities or pursue amusement, hobby, and leisure time interests. Milton has a variety of such attractions including a historical covered bridge, and a historic Baptist Church. Milton hosts the West Virginia Pumpkin Festival lasting four days, and attracting up to 50,000 visitors. Other popular events include the Cabell County Fair, the Corn Maze, and various town parades. (US Census Bureau 2000). Table 3 shows the percentage of persons employed in the town of Milton in Educational Health and Social Services, Retail Trade, Arts, Entertainment, Recreation, Accommodation and Food Services. Educational, Health and Social Services is the highest employing industry in the town of Milton, with 23% of employed persons working in this sector.

Table 3, Industry

% of town Employed

	Educational Health & Social Services		**Retail Trade**		**Arts, Entertainment, Recreation, Accommodation and Food Services**	
	1990	**2000**	**1990**	**2000**	**1990**	**2000**
Milton	20.1%	22.8%	26.0%	15.2%	7.2%	10.1%
Hurricane	16.6%	18.3%	22.1%	12.5%	6.6%	7.3%
Barboursville	22.1%	31.5%	33.5%	18.8%	4.7%	5.6%

f. 0.2%-chance (500-year) Floodplain

As shown on the figure 1 below nearly all of the town of Milton lies within the 500 (.002) year floodplain.

Figure 1
Study Area Map
0.2%-chance (500-year)
Floodplain Limits

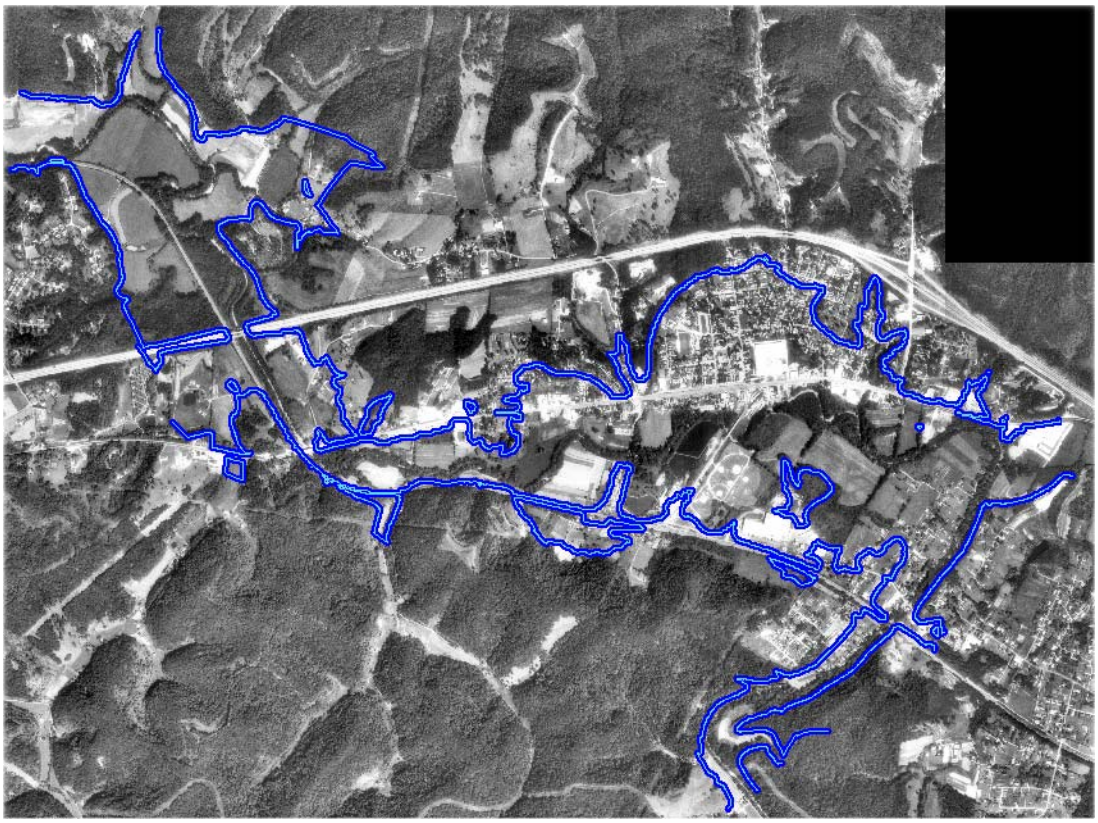


Table 4 shows the reach delineation information for the Milton Lower Mud River feasibility study

TABLE 4
LOWER MUD RIVER LPP, MILTON WV
FLOOD REDUCTION FEASIBILITY STUDY
REACH DELINEATION INFORMATION

Reach Name	Stream	Beg. Stream mile	End. Stream Mile	Notes
Milton	**Lower Mud River**	15.7	20.5	East end of Milton at the Intersection of Woodland and US Route 60 to Intersection of Stewart St and Route

g. Number of Structures

The number of structures in the project was determined based upon GIS data, site surveys, and county assessors' data and parcel maps. Elevations of structures were obtained from the Natural Resources Conservation Service (NRCS) during site surveys using land surveying techniques. Where the NRCS data did not provide elevations, these were estimated during site visits with 1' contour mapping. Table 5 below displays the number of structures by category and flood event based on zero damage elevations. The count based on "zero damage elevations" includes structures which would have flood water on them with the indicated events, even if below the first floor.

Table 5
Lower Mud River
Existing Condition Number of Structures
by Category and Flood Event
(Based on Zero Damage Elevations)

	Flood Event Chance of Occurrence							
Category	100%	50%	20%	10%	5%	2%	1%	.2%
Residential	1	17	78	168	286	415	465	535
Commercial	0	1	13	33	62	109	119	126
Mobile home	0	0	0	38	43	44	45	45
Public	0	2	10	12	19	21	22	22
Total	1	20	101	251	410	589	651	728

As shown on Table 5, there are approximately 688 structures in the 0.2% chance (500-year floodplain). Out of this total, about 72.5 % are residential, 18% are commercial (office, retail, restaurant, service), 6.3 % are mobile home, and 3.2% are public.

h. Structure Inventory

Aerial photography was flown by Earth Data Aviation, Hagerstown, Maryland on April 13, 1999 to a scale of 1:7200. Digital mapping and ground control prepared by GRW, Inc., Lexington, Kentucky. Primary grid based on West Virginia coordinate system, south zone, (NAD 1927). Vertical control was based on NGV 1929. Two foot topographic mapping was developed from the photography and ground control. After it was determined that the project needed reformulation and that levee projects in closer proximity to the town would need to be developed, more coverage and better accuracy would be required. Aerial photography was then flown by Aero-Metric, Inc., Sheboygan, Wisconsin on March 19, 2001 to a scale of 1:4000. Digital mapping and ground control prepared by Aero-Metric, Inc. Primary grid based on West Virginia State Plane Coordinate System (SPCS), south zone, NAD 1927. The vertical control was based on NGVD 1929. One foot topographic mapping was developed from the photography and ground control.

Depreciated replacement values were estimated for all structures in the study area in the following manner. Three separate data sets were used to develop a complete list of structure depreciated replacement values. The first set of structure value data that was available was a previously developed list by the NRCS. This data set of structure depreciated replacement values was updated by first adjusting the structure values to current price levels using the consumer price index (CPI). The second set was obtained from the Cabell Co. Property Valuation Assessors Office. This second available database of structure values was determined by obtaining values of improvement from assessor's data and adjusting these to current price levels. This data set is of structure values only, as the assessor's office separates land from the structure. Extensive comparisons of tax assessor's values were made to depreciated replacement values obtained by Marshall and Swift: they show negligible differences. This data was then linked to the other two data sets and their values were compared. There was a small percentage of structures whose values did not closely match the other two data sets. Where this was the case, the depreciated replacement value was estimated by taking the average of the estimates from the other two data sets.

The third set of structure values is depreciated replacement values made by using the Marshall and Swift valuation services. Depreciated replacement values for all commercial structures in the project area were generated individually with Marshall and Swift. Depreciated replacement values for around 60% of the residential structures were done via block sampling. Block samples were formed with clusters of structures with similar characteristics. Photographs of the structures were available through the assessor's data, and each structure was verified by windshield survey to determine the likeness of each block of structures. After the houses were clustered into blocks, houses were randomly selected from that block and a Marshall and Swift evaluation was performed. Marshall and Swift Valuation Service per square foot values were applied to the square footage of each like floodplain structure (obtained from assessor's data). Values per square foot varied by occupancy type (residential, office, etc.), condition, type and quality of construction. Local multipliers to adjust the value estimates to the Milton/Cabell County area were also applied. This value was then placed on the houses within that block.

Value estimates for a small percentage of structures were missing from both the NRCS data set and the assessor's tax set. When this occurred, the depreciated replacement values for the missing structures used in the economic analysis were the average of the value estimates of the two other data sets. All the sets were compiled and adjusted within a 15% coefficient of variation, the average value of the three sets of structures was recorded and used as the value for that structure in the economic analysis.

Table 6 which follows, displays estimates of value of development which includes depreciated replacement values for structures and estimated values of contents up to the 0.2%-chance (500-year) floodplain.

Table 6
0.2%-Chance (500-year) Floodplain
Existing Condition Value of Development
by Category and Flood Event
(FY 2003 Price Levels x $1,000)

Category	Flood Event Chance of Occurrence							
	100%	50%	20%	10%	5%	2%	1%	.2%
Residential	$33	$154	$1,001	$2,592	$5,177	$11,189	$16,413	$25,342
Commercial	$0	$1	$152	$1,034	$2,605	$9,013	$16,118	$24,822
Mobile home	$0	$0	$0	$0	$87	$407	$650	$894
Public	$6	$327	$1,870	$4,717	$8,604	$12,499	$14,164	$16,104
Total	$39	$482	$3,023	$8,343	$16,473	$33,108	$47,345	$67,162

The table above shows the depreciated replacement value of structures and contents in the 0.2%-chance floodplain is approximately $67,162,000. Residential structures account for approximately 37.7% of the total value of floodplain structures. Commercial properties account for roughly 37.0%. Public properties account for about 24.0% of total floodplain property value and mobile homes 1.3%.

WITHOUT PROJECT DAMAGES

a. Historical Flood Problem

Milton began recording its floods in the early 1900's. Major floods occurred in 1913, 1939, 1978, and 1997. The 1997 flood, an estimated 27 year event, inundated a substantial part of Milton in what is now considered to be the flood of record. Flood conditions at Milton are a result of both natural features and urban development. Upstream from Milton the Mud River watershed is characterized by steep gradients and rather narrow valleys which can cause high flood peaks. When the flows reach the wide floodplain at Milton, the flood waters spread out over the valley inundating much of the business and residential areas located north of Mud River between US 60 and I-64. From 1913 until present the lower Mud River's floodplain has been altered. This development of the flood plain filling has shifted the stream out of equilibrium and constricted the stream's natural flow causing flooding to occur more frequently.

b. Methodology

Without project condition, structure and content damages were computed utilizing the @Risk commercial software package and the HEC-FDA Flood Damage Analysis Model, Version 1.2. These models integrate hydrologic and hydraulic data with economic data to compute both

damage by flood event and expected annual damage. The @RISK program was used to develop the stage-damage curves using structure and depth information developed by GIS. Key economic uncertainty assumptions, which are input into the @RISK model, include:

1) **Struc*ture Value*** - Errors are likely to occur in estimating the depreciated replacement values of structures. Based upon past Corps studies, the coefficient of variation used in @RISK for structure values all damage categories ranges from 14%-19% (standard deviation equals 14%-19% of the mean value). The probability distribution is assumed normal. Structure values were obtained from an average of the three data sets previously described.
2) ***Content Value*** - Errors are likely to occur in estimating content values. Based upon past Corps studies, the coefficient of variation used in @RISK for all damage categories is 15% (standard deviation equals 15% of the mean value). The probability distribution is assumed normal.
3) ***First Floor Elevations*** – Errors are likely to occur in surveying the first floor elevations of structures. A 0.6 standard error was used in @RISK to account for potential measurement errors associated with the land surveying methods used. Less than 5 percent of the FFE were estimated by windshield survey using 1' contour mapping. The remaining elevations were obtained by land survey, as previously described.
4) ***Depth-damage Curves*** - Errors are likely to be present in post-flood surveys used to determine structural and content depth-damage relationships. Corps' depth-damage curves include standard deviations, and for the Milton Study we used the highest standard deviations at any specific depth. A 15% coefficient of variation (standard deviation equals 15% of the mean value) was used in @RISK for commercial and residential damage categories. The generic depth damage functions published in the Economic guidance memorandum 01-03 were used for the estimation of residential damage for both structure and content in this evaluation. The Sacramento District was contacted and it was determined that these curves were appropriate because flooding characteristics were similar freshwater, several days duration, low velocity, and silt and debris. The Commercial generic depth damage curves used were the 1988 Federal Emergency Management Administration (FEMA) curves. The HEC-FDA model computes expected annual damages using a Monte Carlo simulation process. Expected annual damages are calculated for each plan, analysis year, stream, and damage area in multiple iterations by using the stage-damage curves developed in @Risk.

1) ***Structure data***—including: structure I.D.; category (public, commercial, residential, mobile home); flood depths for the 500, 100, 50, 20, 10, 5, 2, and 1-yr.

2) ***Hydrologic and Hydraulic data***, including frequency/discharge and stage/discharge relationships. This data, furnished by Engineering Division, was developed utilizing the HEC-RAS Water Surface Profiles program. The output files were imported into the HEC-FDA program. Data represents FY 2003 conditions.

3) ***Risk and Uncertainty variables***. The major variables for which uncertainties are estimated include discharges and stages of flooding. The hydrologic engineering relationships for which uncertainties are accounted for are frequency/discharge and stage/discharge. For the frequency/discharge relationship, the model computed a statistical distribution using the graphical approach, based upon data contained in the water surface profiles and equivalent record lengths for each reach furnished by

Huntington Engineering and Construction Division. For the stage/discharge relationship, a normal distribution is assumed. The Engineering Division provided standard deviations of errors for the 100-year frequency as the frequency where errors become constant. The HEC-FDA program then calculates standard error estimates for more frequent events.

Finally, this economics analysis includes only damages to structures for the Town of Milton project study area.

c. Damage Estimates

Table 7 shows flood damage by event and category

Table 7
Existing Condition Flood Damage
by Category and Flood Event
(FY 2003 Price Levels x $1,000)

	Flood Event Chance of Occurrence							
Category	100%	50%	20%	10%	5%	2%	1%	.2%
Residential	$12	$207	$1,093	$2,901	$5,964	$11,903	$16,572	$22,382
Commercial	$7	$121	$641	$1,700	$3,495	$6,975	$9,712	$13,117
Mobile home	$0	$4	$22	$57	$118	$235	$327	$442
Public	$17	$289	$1,525	$4,046	$8,319	$16,603	$23,116	$31,220
Total	$36	$621	$3,281	$8,704	$17,896	$35,716	$49,727	$67,161

As shown in table 8 below, the category with the most expected annual damages was public with $1,666, which amounts to 48% of the total without project expected annual damages. This is due to the fact that Milton Elementary and the old Milton High School buildings are located in the floodplain. Nearly all of the town's municipal buildings are also located in the floodplain.

Table 8 summarizes without-project expected annual structural and contents damages by reach for Base Year 2003.

Table 8
Without Project Conditions
Expected Annual Damages
(FY 2003 Price Levels In $1,000s)

Town of Milton	Residential	Commercial	Mobile Home	Public	Total
Aggregated Structures & Contents	$1,194	$700	$24	$1,666	$3,584

d. Other Damages

Emergency costs and clean up costs were not calculated due to lack of information gathered during flood events. A great deal of this work was done by church and local volunteers. The National Guard was also involved in policing and cleanup. Others damage categories not included in this evaluation are automobile damage, traffic diversion, and roads & utilities.

ANALYSIS OF FLOOD REDUCTION ALTERNATIVIES

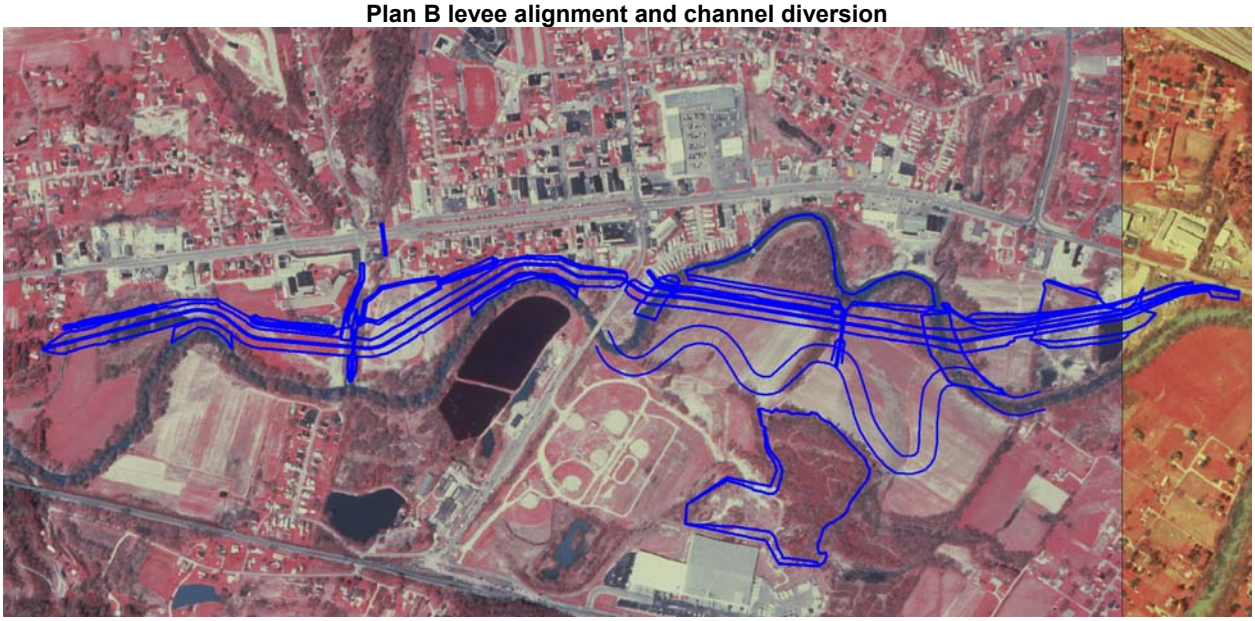
e. Lower Mud River/Milton Floodplain

Two alternatives have been carried forward for detailed economic analysis. The first plan is a levee with a 3000 feet channel diversion. The second is a low levee that runs along the bank and follows the contours of the Mud River. Descriptions of other alternatives that were considered during preliminary screening may be found in the main report.

Alternative 1 (Plan B)

This levee alternative involves the construction of a new section of channel near the upstream end of the project. The levee would begin at the eastern edge of Milton near 84 Lumber, extend from US 60 south and then west about 1,800 feet crossing the Mud River, then west about 2,200 feet crossing the Mud River again before reaching the Fairground Road Bridge. At this point the levee would continue west along the north riverbank, about 2,000 feet to the Newman's Branch and then continue along the river bank for about 2,000 feet to high ground near Abbot Lane. The total length of this levee would be approximately 8,000 feet, including 3,000 feet of new river channel.

FIGURE 2
Plan B levee alignment and channel diversion



Alternative 2 (Plan D)

This alternative provides a relatively low levee that could be constructed entirely along the river bank of the Mud River without any channel modification and provides protection against a 5%-chance event. The embankment would begin just west of John's Branch and continue south and west about 1,000 feet to the Mud River. The levee would then continue west along the north river bank about 1600 feet to the Fairgrounds Road Bridge abutment. This levee would have a total length of about 6,000 feet and would require two small pump stations, but no highway closures.

Figure 3
Levee Alignment

f. Residual Damages & Benefits

The following tables summarize the residual expected annual damages and benefits for each alternative.

Table 9 shows residual expected annual damages and damages reduced (Benefits), respectively, for each Alternative.

Table 9
Lower Mud River/Town of Milton Alternatives
Residual Expected Annual Damages and
Annual Benefits (Structure & Contents)
By Alternative
(FY 2003 Price Levels In $1,000s)

Alternative	Plan B	Plan D
Residual Damages	$157	$1,282
Annual Benefits	$3,427	$2,302
Damages reduced (%)	96%	64%

g. Residual Damages

Residual damages were calculated for Plan B and Plan D levee alternatives employing the same methods as for existing condition damage estimates with elevations included in the modeling. Total expected annual damages without project were $3,584. Total expected annual damages with project for the Plan B alternative was $157 and $1,282 for the Plan D alternative. Above normal duration of flooding was not taken into account in this estimate. There is a $1,125 difference in residual damages over the Plan B levee verses the Plan D. This is primarily due to the height of the levee for Plan D. The top of the levee for Plan D was set by designing the highest possible levee that could be built along the Mud River without any gate closures and without a large pump station at John's Branch.

h. Flood Insurance Administrative Costs

Those people purchasing a new home in the 100-year floodplain via a federally-insured loan are required to purchase flood insurance from the National Flood Insurance Program (NFIP). In addition, some banks mandate purchase of flood insurance even if the mortgage is not insured by a federal agency. The amount of the premiums paid by policy holders is comprised of two components: 1) funding for NFIP administrative and overhead costs, including policy-writing, floodplain management, salaries, etc.; and 2) funding for payouts after flood events. The amount paid by policyholders for administrative and overhead costs represent an NED loss, since this money would not have to be expended if the properties were not located in a floodplain. According to the latest guidance (FY 03), overhead and administrative costs represent about $133 per policy. There are approximately 140 properties currently covered by

flood insurance in the study area floodplain. Hence, total administrative and overhead costs total about $18,620 annually.

Table 10 shows the total annual benefits by alternative and category.

Table 10
Lower Mud River/Town of Milton Alternatives
Total Expected Annual Benefits
By Alternative
(in $1,000s)

Category	Plan B	Plan D
Residential	$1,293	$835
Commercial	$1,267	$729
Mobile home	$46	$17
Public	$822	$722
NIFP Reduction	$19	$0
Total	3,446	$2,302

i. Net Benefit Calculation

Analyzed costs were subtracted from total average annual benefits to compute net benefits. Interest during construction (IDC) was added to first construction costs to obtain investment costs. During screening of alternatives, IDC was calculated at 5 7/8% interest over a 60 month construction period. To make this calculation, costs were broken out by construction costs plus contingency.

These were then spread among estimated months of expenditure with assumed mid-month payments. The total expenditure per month was multiplied by its IDC factor, producing monthly IDC. The monthly IDC factor is equivalent to 1 plus the interest rate, raised to the period in months divided by 12, minus 1. This calculation is illustrated below.

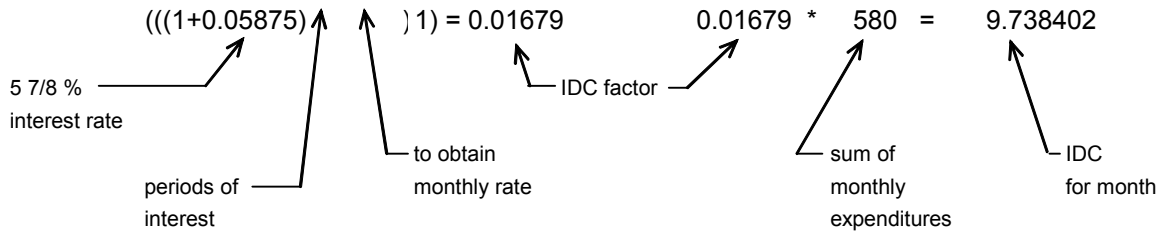


Table 11 displays the project costs for Alternatives B and D.

Table 11
LOWER MUD RIVER LPP, MILTON WV
FLOOD REDUCTION FEASIBILITY STUDY
Project Costs ($ 1,000s)

Item	Plan B (Levee/channel)	Plan D (Low Levee)
First Cost	$38,657	$27,560
Interest During Construction	$4,420	$3,151
Total Investment Cost	**$43,077**	**$30,711**
Annualized (5-7/8%, 50 yrs)	$2,685	$1,915
Annual Operation & Maintenance	$32	$23
Total Annual Cost	**$2,717**	**$1,938**

Table 12 shows the Benefit/Cost Analysis for Plans B and D

j. Benefit/Cost Analysis

Table 12
Lower Mud River/Town of Milton Alternatives
Benefit/Cost Analysis (in $1,000s)

	Plan B (Levee/channel)	Plan D (Low Levee)
Expected Annual Benefits	$3,446	$2,302
Expected Annual Costs	$2,717	$1,938
Net Benefits	$729	$364
Benefit/Cost Ratio	1.3	1.2

The National Economic Development (NED) plan is the plan which reasonably maximizes net benefits consistent with the Federal objective. As shown above, Plan B has the highest net benefits. Therefore, Plan B would be considered the NED Plan.

Table 13 Shows Number of structure by event and category for Plan

Table 13
Flood Damage for Plan B
by Category and Flood Event
(FY 2003 Price Levels x $1,000)

Category	Flood Event Chance of Occurrence							
	100%	50%	20%	10%	5%	2%	1%	.2%
Residential	$0	$0	$0	$0	$0	$0	$0	$22,382
Commercial	$0	$0	$0	$0	$0	$0	$0	$13,117
Mobile home	$0	$0	$0	$0	$0	$0	$0	$442
Public	$0	$0	$0	$0	$0	$0	$0	$31,220
Total	$0	$0	$0	$0	$0	$0	$0	$67,161

Table 14 shows the number of structures with plan B by category and flood event.

Table 14
Lower Mud River
Number of Structures with plan B
by Category and Flood Event
(Based on Zero Damage Elevations)

Category	Flood Event Chance of Occurrence							
	100%	50%	20%	10%	5%	2%	1%	.2%
Residential	0	0	0	0	0	0	0	535
Commercial	0	0	0	0	0	0	0	126
Mobile home	0	0	0	0	0	0	0	45
Public	0	0	0	0	0	0	0	22
Total	0	0	0	0	0	0	0	728

k. Residual Flood Risk

Table 15 shows benefits by probability of occurrence based on the results of the risk-based analysis.

Table 15
Expected Value and Probabilistic Values of EAD and EAD Reduced

Plan	Expected Annual Damages			Probability EAD Reduced Exceeds Indicated Values		
	Without Plan	With Plan	Damage Reduced	.75	.5	.25
B	$3,584,010	$156,870	$3,427,140	$2,580,360	$3,338,700	$4,193,150

PROJECT PERFORMANCE

Based upon the analysis completed in the previous section, it was apparent that the economic feasibility of Plan B (Levee / Diversion) was the best from an NED perspective.

a. Risk & Uncertainty

Table 16 displays estimates of flood risk generated by the HEC-FDA program based upon with and without project conditions.

Target Stage Expected Annual Exceedance Probability

These statistics show the expected annual probability that the capacity of the channel within these reaches will be exceeded. The Target Stage represents the stage at which significant damages begin to occur for without project conditions or the top of the levee if one is located in the reach. Table 16 shows that for Plan D, there is a 2.9% chance that the capacity of the Mud River will be exceeded and a .01% chance that Plan B (Levee/channel) will be exceeded. Under Without Project Conditions, annual exceedance probabilities were approximately 9%.

Long-Term Risk

Long-Term Risk represents the probability of the Target Stage being exceeded (or exceeding the capacity of the reach) over a given time period. Under Without Project Conditions, there is over a 100 percent chance that capacity of the reach in the study area will be exceeded over the 50-year period of analysis. Table 16 displays the long-term risk for 10, 25 and 50-year periods for both alternatives. As shown on the table, the long-term risk over the 50-year period of analysis ranges from about 26% to about 77% for the with project conditions along the damage reach for Plan D. The long-term risk over the 50-year period of analysis for Plan B ranges from

less than 1% to about 4% for the with project conditions along the damage reach.

Conditional Non-Exceedance Probability by Event

The conditional non-exceedance probability by event represents the probability of the project containing the given probability event within the Target Stage for the reach, should that event occur.

Table 16 shows that the conditional non-exceedance probability for the one-percent flood event. Conditional non-exceedance probability is 11.4% for Plan D and 98% for plan B for the study area under both types of alternatives.

Table 16
Lower Mud River Feasibility Study
Risk & Uncertainty Results – Low Levee & Levee/Channel Plans

	Target Stage Exp. Annual Exceedance Probability	Long-Term Risk			Conditional Non-Exceedance Probability by Event					
		10 Yrs	25 Yrs	50 Yrs	10%	4%	2%	1.0%	0.4%	0.2%
Lower Mud River										
W/O	9.0%	95.01%	99.9%	100%	1.02%	0.04%	0.0%	0.0%	0.0%	0.0%
Plan B Levee/Channel	0.1%	0.79%	1.96%	3.88%	99.99%	99.98%	99.96%	98.09%	79.74%	56.57%
Plan D Low Levee	2.9%	25.75%	52.5%	77.43%	99.83%	76.68%	34.21%	11.4%	2.49%	.93%